ON A REMARKABLE EXPOSURE OF COLUMNAR TRAP NEAR ORANGE, NEW JERSEY.

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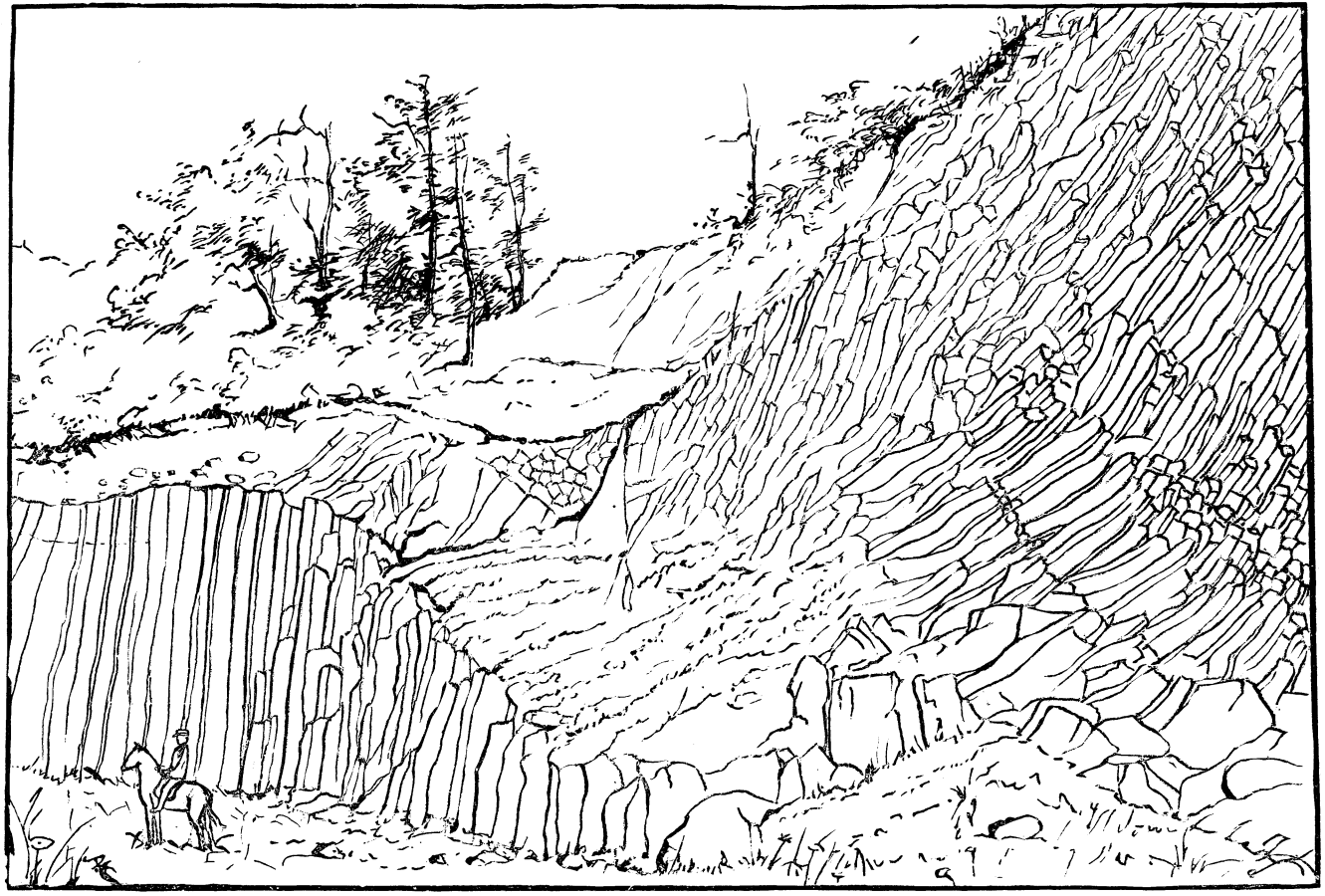
The remarkable exposure of trap, near Orange, New Jersey, to which attention has recently been called by the State Geologist, Prof. George H. Cook, is in many respects the finest example of geotechnic architecture to be found in the Eastern United States. Although a true columnar structure is by no means a rarity in this State, indeed, rather the contrary, yet strikingly enough, where any extensive exposure of the trap occurs, there the columnar structure appears to be in most instances either only partially developed, or where developed, only of a very indeterminate character. This is well shown in the case of the Palisades fronting the Hudson River, where, for the greater part of their extent, only an approximation to anything like such structure can be made out. In the case of the locality presently to be described, however, which is situated on the face of the first interior ridge trending parallel with the Palisades, whose age probably differs but little, if at all, from that of the Palisades, we are presented with the reversed condition of things; the columnar structure is here developed, not only on a most imposing scale, but in all the varied conditions under which such structures appear.

The exposure of O'Rourke's quarry (Plate VIII) is located some one and a half or two miles back of Orange, on the slope of Orange Mountain, and, consequently, in the line of the first trap ridge. It measures 750 feet in length, and 98 feet 2 inches greatest height above the base or working line. The material quarried (worked now for a considerable number of years) is the familiar post-Triassic (?) "trap," or "greenstone," the material of the Palisades quarries, which, until recently, supplied the city of New York with a great part of the Belgian paving blocks. That which immediately arrests the attention of the visitor to the quarry is the magnificent display of the columnar structure, thousands of basaltic columns of the hexagonal and pentagonal pattern appearing, if not in the absolute perfection of the similar columns of the Giant's Causeway and Fingal's Cave, in a perfection but very little inferior to these. The base or lower half of the exposure is



HEILPRIN ON COLUMNAR TRAP.

made up of a vertical palisade of 120 or more columns, measuring individually from 15 to 40 or 42 feet in height, and from 3 to 5 feet, or even more, in thickness. Towards the middle the height of this palisade has been greatly reduced, partly through the failing of the columns themselves, and partly through the artificial destruction that has here been effected. Above this line, which in some parts is sheared off as evenly as though it had been manipulated by the hand of man, the columns suddenly diminish in size, and instead of retaining the vertical position, now arch diagonally upward and outward, meeting from opposite sides to form an apex immediately under the highest point of the exposure. Many of the columns rest horizontally, or nearly so. Beyond the horizontal layer, what may be considered as a third series of columns makes its appearance, and here, again, the vertical position is assumed. The material of the glacial drift, as indicated by a heterogeneous assemblage of pebbles and boulders, rests on top, forming the subsoil of the region.

The first impression produced upon the casual observer by the complete exhibit is one indicating disturbance; the arched or diagonally inclined, and apparently disturbed, position of the columns of the upper and inner portion of the mass, would seem to imply an upheaving thrust from below, just underneath the apex. In other words, it would appear that we were over the seat of some subterranean disturbing force, or in the centrum of volcanic action, and, therefore, in the position of a true vent. But had there been such a thrust as is here implied, we should expect to see its effects revealed in a fracture or dislocation below the top, whereas none such is apparent. On the contrary, the continuity of the columnar mass is fully as well marked on top as anywhere else, and no indications of special disturbance are anywhere manifest. We are hence forced to the conclusion that the irregular and apparently disturbed position of the columns is not in reality due to any disturbing agent, but is merely the result of peculiar conditions of cooling and solidification of the original molten substance (lava). In other words, while some portions of this molten lava "crystallized" into vertical prismatic columns, other portions "crystallized" horizontally, and in all the intermediate planes lying between the horizontal and vertical. This irregular method of columnar formation, a perfect parallel of

which is observed along the River Alignon in the Ardèche, was first critically discussed by the late Poulett Scrope, who investigated its causes midst the volcanic debris of Central France, and clearly determined that it was the result of irregular convection and radiation of heat, and consequent irregular solidification. The deep layers, where the loss of heat was effected slowly through conduction with the underlying rock, produced stout vertical columns; the more superficial layers, where radiation was most active, frequently produced horizontal columns, while between the two were found columns occupying all the intermediate positions.